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ABSTRACT

A method of evaluating the Secondary School Mathematics Curriculum Improvement Study (SSMCIS) now in its fourth year at Teachers College, Columbia University, is discussed. The main task of SSMCIS is the production and tryout of textbook materials, although teacher training is also an important component. Informal teacher feedback and sporadic testing provide the main thrust of evaluation of this program to date. One study notes the discrepancy between the views of teachers and students on some features of the text materials and suggests the need to acquire more direct information from the students concerning course materials than has previously been the case. Most of the evaluation activities have concentrated on support functions rather than the project itself. The question of whether full-scale formative evaluation of the study would be any more effective in influencing curriculum revision is raised in the conclusion. (AE)

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Evaluating a Unified Mathematics Curriculum*

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Despite the widely-held view that the past decade or so has seen a revolution in our school mathematics curriculum, a convincing argument can be made that to date the reform has been chiefly an up-dating of the traditional curriculum. The big breakthrough--a restructuring of the curriculum that would abandon the separation of mathematics into compartments labeled "arithmetic," "algebra," and "geometry"--has yet to occur. Since the turn of the century, educators have been calling for a school mathematics program that would be organized around the fundamental concepts and structures of mathematics--concepts such as sets, relations, mappings, and functions; structures such as groups, fields, and vector spaces. Yet the traditional course boundaries have proved remarkably impervious to change.

One attempt to produce a unified mathematics curriculum for grades 7 to 12 is the Secondary School Mathematics Curriculum Improvement Study (or SSMCIS), located at Teachers College, Columbia University, directed by Howard F. Fehr, and now in its fourth year. Influenced by work in this country such as the Report of the Cambridge Conference on School Mathematics and by European attempts to reconstruct the mathematics curriculum, the SSMCIS is developing a curriculum for college-capable students--specifically the upper 15 to 20 percent of the population in mathematical ability. The goal is to use the unifying concepts of mathematics as a more efficient basis for organizing the curriculum so that much that has been considered undergraduate mathematics can be introduced into the high school program.

The main task of the Study has been the production and tryout of text materials, although teacher training has been an important component. The typical mode of operation for the textbook writing has been as follows. After a panel of consultants (mathematicians and educators) has set up the broad outlines for a course--in line with the overall syllabus plan adopted at the outset of the Study in 1966--a conference of writers and consultants is held in June to hammer out the details of each new course, as well as to suggest revisions of material previously written. A preliminary version of each new course is written during the remainder of the summer, tried out during the year in a half dozen or so classes in the Metropolitan New York area with two teachers per class, and then revised the following summer

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in the light of information from tests, observations, and reports from the teachers. The teachers receive special training each summer at Teachers College, and in addition, use their previous year's experience to assist in preparing teacher's commentaries for the courses undergoing revision.

At present the experimental version of Course IV (tenth grade) is being tried out in five classes. Final versions of Courses I and II (grades 7 and 8) are available now; the revision of Course III will be ready in the fall. Even though most teachers need special preparation to teach the materials--receiving it chiefly through summer institutes at Teachers College, the University of Maryland, and the University of Arizona--the number of classes using the materials has risen markedly each year, so that currently there are about 150 classes using Course I and 70 classes using Course II.

The accelerating rate of adoption of these challenging and unusual materials suggests that SSMCIS must be doing something right, but of course one of the functions of evaluation is to check the nature and validity of this "something" that seems to be so right.

I would like to take the rest of my time here today, therefore, to sketch some of the problems and prospects of evaluating the SSMCIS program. Those of you who would like further details on the nature of the SSMCIS curriculum may write Professor Howard Fehr, Director of SSMCIS, at Teachers College and request the current information bulletin. Also, an article on the SSMCIS by Fehr and James Fey appears in the December 1969 issue of the American Mathematical Monthly.

I think it's fair to say that various forms of "teacher feedback" have been the major source of evaluation used by SSMCIS in revising its materials. One of the advantages of a small project, with tryout centers located nearby, is that the teachers of the experimental classes become an integral part of the project, providing a sort of continuous monitoring of the curriculum's effectiveness. Our staff knows the teachers personally, can visit their classes frequently, and can respond at any time to questions or requests for assistance. In addition to their work with the writing teams during the summer, the teachers of the experimental classes convene at Teachers College several times during the year for an all-day Saturday meeting, when progress can be assessed and common problems discussed.

Student performance on tests constructed by the staff does, of course, provide information about the materials. To date, however, the tests have been used more to indicate

student's progress to teachers, administrators, parents, and the students themselves than to diagnose weak spots in the materials. We are currently trying to make our tests more diagnostic by being a little more careful and systematic in constructing items to fit the taxonomy of objectives devised at the outset of the study.

Several research studies done in the Department of Mathematical Education at Teachers College have treated various facets of the SSMCIS program. The one that deals most directly with questions of program evaluation has just been completed. It is the doctoral dissertation of Brother Michael Hoban, and it is a kind of intrinsic, non-comparative evaluation study. Brother Hoban took one chapter from Course II--the eighth grade course--dealing with transformation geometry and attempted to judge the effectiveness of the chapter (and the teachers) in meeting the objectives laid out for it. A four-man jury of mathematicians and mathematics educators associated with the project judged the evaluation blueprint Hoban devised and test items he wrote. Items that survived this screening were pilot tested in parallel forms to determine the necessity for a pretest and to eliminate items that failed to discriminate.

In the main study, 9 classes studied the chapter and then took a posttest comprised of items that survived the screening and the pilot testing. While the chapter was being taught, observations were made of the classrooms, and after the testing, questionnaires were administered to students and teachers.

Because Hoban used a combination of results from the pilot test, the juror's ratings of item difficulty, and his own judgment in setting performance standards for the test, the test cannot, strictly speaking, be called "criterion-referenced." And because he was unable to come up with a workable scheme for rating classroom behavior, he lost a good opportunity to study how class achievement might have been related to the teacher's handling of material.

Nonetheless, the study does suggest that the materials are relatively successful--most of the classes met the standards set for them on most of the items. Moreover, there were indications that both teachers and students found the ideas of transformation geometry treated in the chapter to be interesting and enjoyable to study.

Perhaps the most important finding was the uncovering of a discrepancy between the views of teachers and students about some features of the text materials. Whereas the

teachers considered the reading level and the way new terms and definitions were introduced to have been appropriate, students claimed they had some difficulty in reading the chapter and in understanding all of the new terminology. On the other hand, there were some concepts (translation and rotation, for instance) that the students claimed they understood but that the teachers weren't sure the students had completely grasped. And in general, the students were more concerned than teachers apparently thought they were about the "need" for studying transformation geometry and its practical value.

This suggests that we in the project should begin to get more direct information from the students about their reactions to the materials, to supplement the teachers' views. After all, these students are bright and articulate. Though they may lack the perspective on the curriculum that a teacher might have, they should be reasonably competent critics of what they are learning and reasonably able to convey their criticisms to us.

In the SSMCIS project many of our "evaluation" activities have a support function--for instance, the provision of midyear and final examinations for each course, the development of special Regents examinations for our classes in New York State, and perhaps eventually the development of alternative college entrance examinations. These activities, important though they may be, take up the bulk of the limited time and manpower we can give to evaluation. I don't see much prospect of our being able to do much more in the way of formative evaluation than we are already doing.

At the risk of claiming virtue for necessity, then, let me raise the question of whether we should attempt to do more even if we could. What I mean is this: it has been my experience in this project and in others that when writing textbooks for school children, mathematicians are guided more by their own internal vision of how things ought to be than by anything else. Rational arguments from their colleagues can roll off their backs like water. Let me leave the question for you to ponder, as I have: would a full-scale formative evaluation be any more effective in influencing curriculum revision in a project like ours than the informal teacher-feedback/sporadic-testing model used to date has been? I really wonder if it would be worth the effort to do, even if we could.